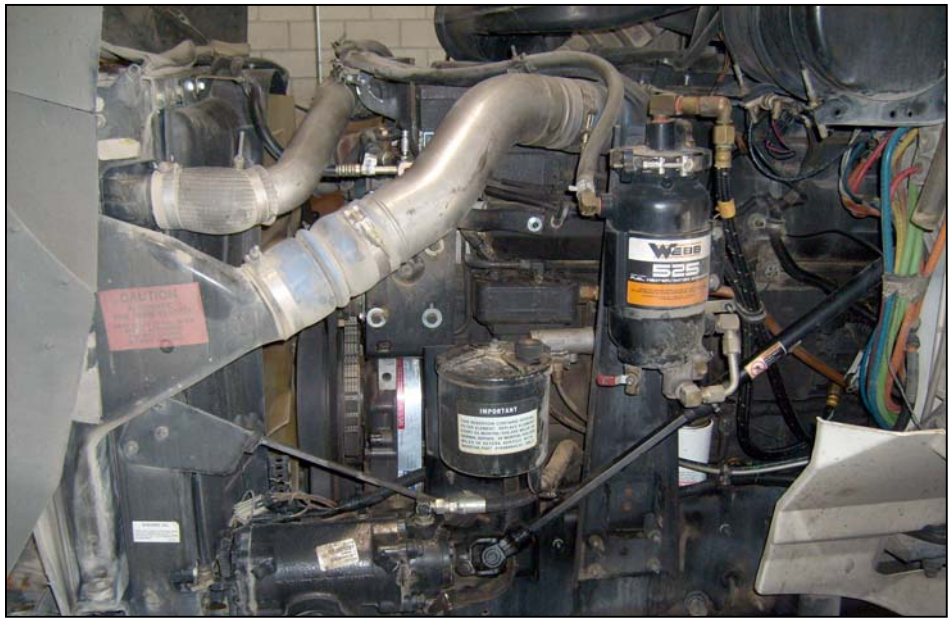
DENSO R5 Starter Installation Guide For:

- **2000 International 9200**
- **Cummins N14 Engine**



This guide will assist the technician with the installation of the R5 starter on this particular application.

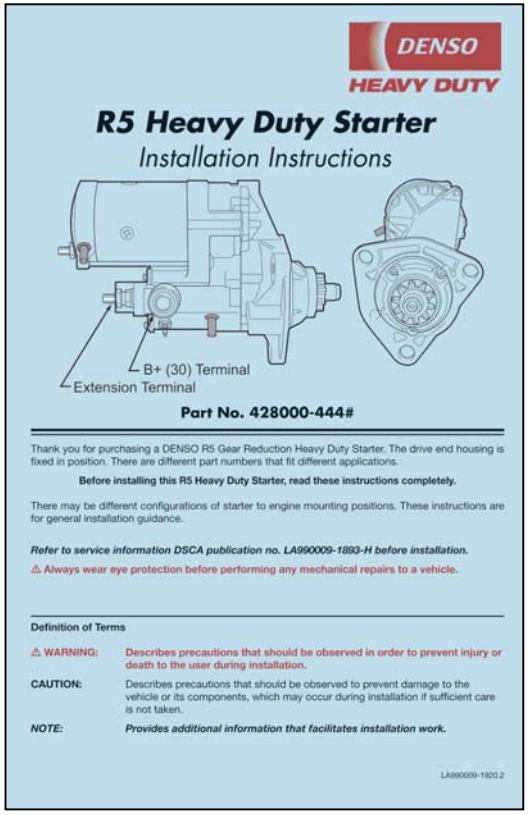
These installation procedures may vary based on the engine and make, model & year of the vehicle.

Prior to component replacement carefully troubleshoot the starting circuit to identify the true cause of failure.

All replaced cables or wiring should match original (OEM) specifications AND when reinstalling bolts and hardware, torque to original specifications.

Starter Preparation

Read all installation instructions & service information carefully before installing the R5 starter.



DENSO HEAVY DUTY

R5 Heavy Duty Starter

Installation Instructions

B+ (30) Terminal
Extension Terminal

Part No. 428000-444#

Thank you for purchasing a DENSO R5 Gear Reduction Heavy Duty Starter. The drive end housing is fixed in position. There are different part numbers that fit different applications.

Before installing this R5 Heavy Duty Starter, read these instructions completely.

There may be different configurations of starter to engine mounting positions. These instructions are for general installation guidance.

Refer to service information DSCA publication no. LA990009-1893-H before installation.

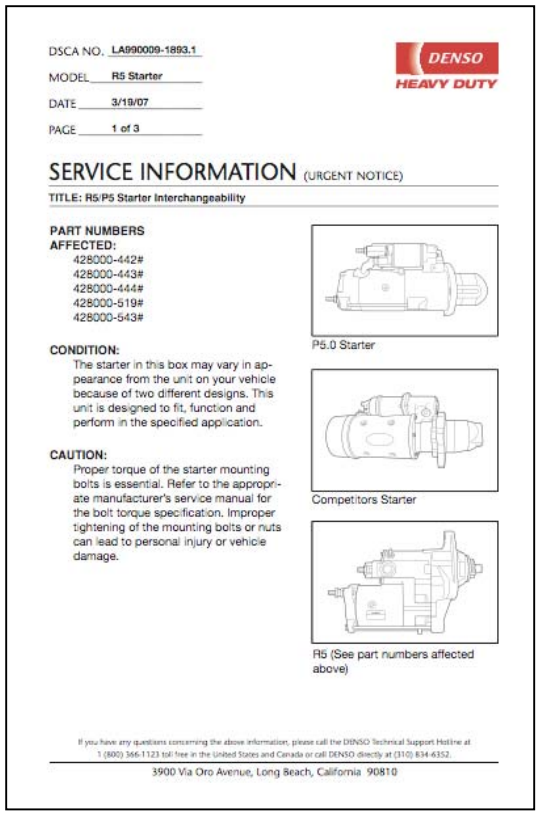
⚠ Always wear eye protection before performing any mechanical repairs to a vehicle.

Definition of Terms

⚠ WARNING:	Describes precautions that should be observed in order to prevent injury or death to the user during installation.
CAUTION:	Describes precautions that should be observed to prevent damage to the vehicle or its components, which may occur during installation if sufficient care is not taken.
NOTE:	*Provides additional information that facilitates installation work.*

LA990009-1920.2

Installation Instructions



DSCA NO. LA990009-1893.1
MODEL R5 Starter
DATE 3/19/07
PAGE 1 of 3

DENSO HEAVY DUTY

SERVICE INFORMATION (URGENT NOTICE)

TITLE: R5/P5 Starter Interchangeability

PART NUMBERS AFFECTED:
428000-442#
428000-443#
428000-444#
428000-519#
428000-543#

CONDITION:
The starter in this box may vary in appearance from the unit on your vehicle because of two different designs. This unit is designed to fit, function and perform in the specified application.

CAUTION:
Proper torque of the starter mounting bolts is essential. Refer to the appropriate manufacturer's service manual for the bolt torque specification. Improper tightening of the mounting bolts or nuts can lead to personal injury or vehicle damage.

P5.0 Starter

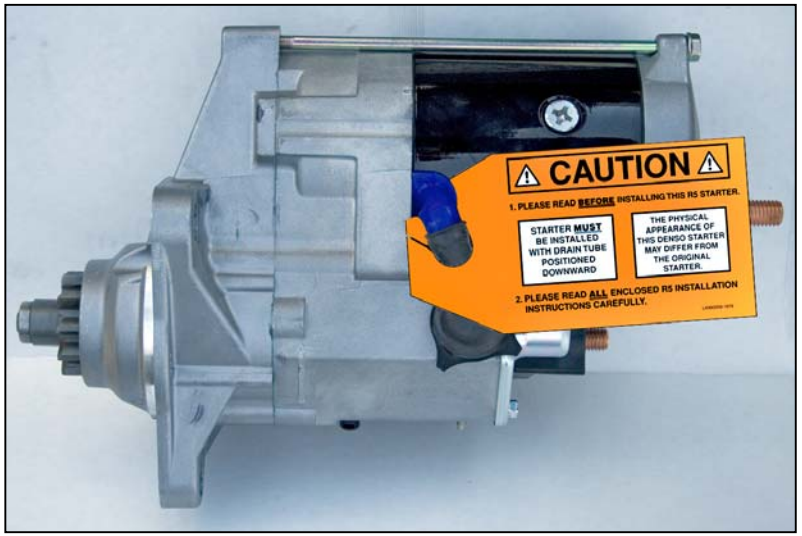
Competitors Starter

R5 (See part numbers affected above)

If you have any questions concerning the above information, please call the DENSO Technical Support Hotline at 1 (800) 366-1123 toll free in the United States and Canada or call DENSO directly at (310) 834-6352.

3900 Via Oro Avenue, Long Beach, California 90810

Service Information

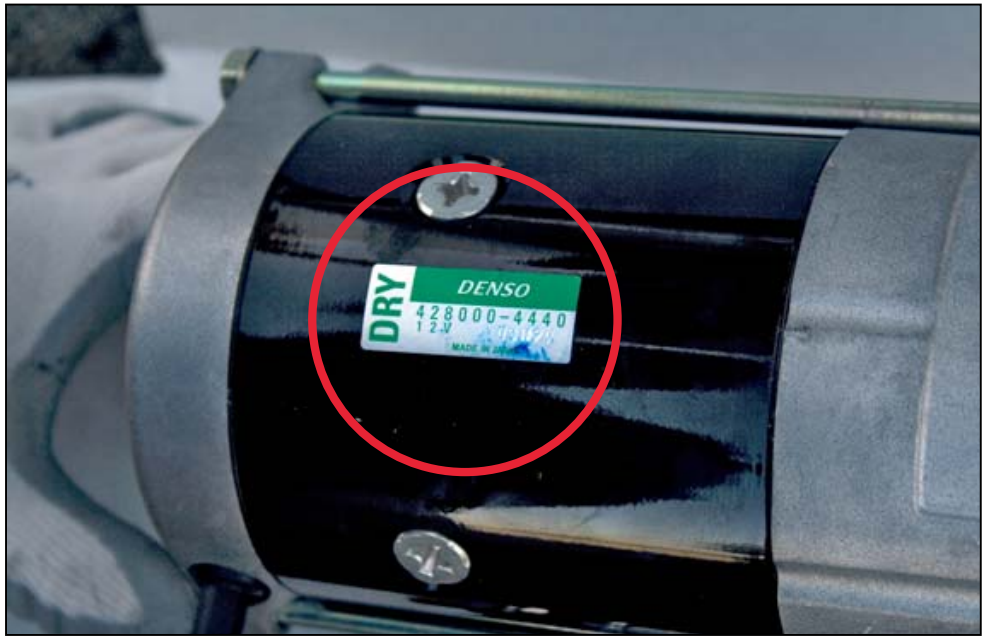

⚠ CAUTION ⚠
1. PLEASE READ BEFORE INSTALLING THIS R5 STARTER.
STARTER MUST BE INSTALLED WITH DRAIN TUBE POSITIONED DOWNWARD
THE PHYSICAL APPEARANCE OF THIS DENSO STARTER MAY DIFFER FROM THE ORIGINAL STARTER.
2. PLEASE READ ALL ENCLOSED R5 INSTALLATION INSTRUCTIONS CAREFULLY.

Caution Tag

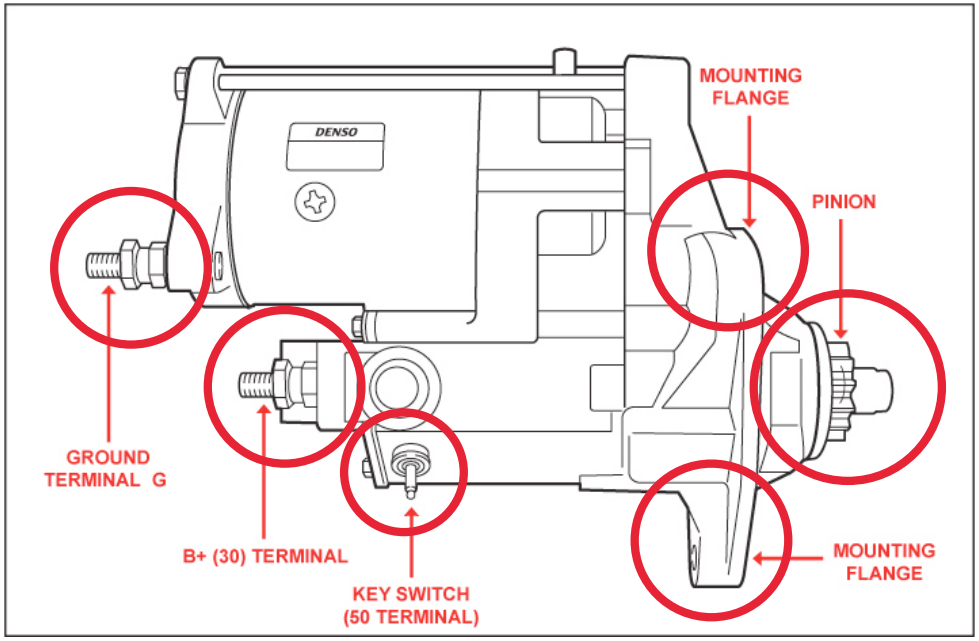
These items are included with the starter.

Starter Preparation

Confirm the correct part number for the particular application.



Visually inspect starter at these critical points.



Proceed to vehicle preparation.

Vehicle Preparation

Locate the vehicle battery compartment and remove the battery cover.

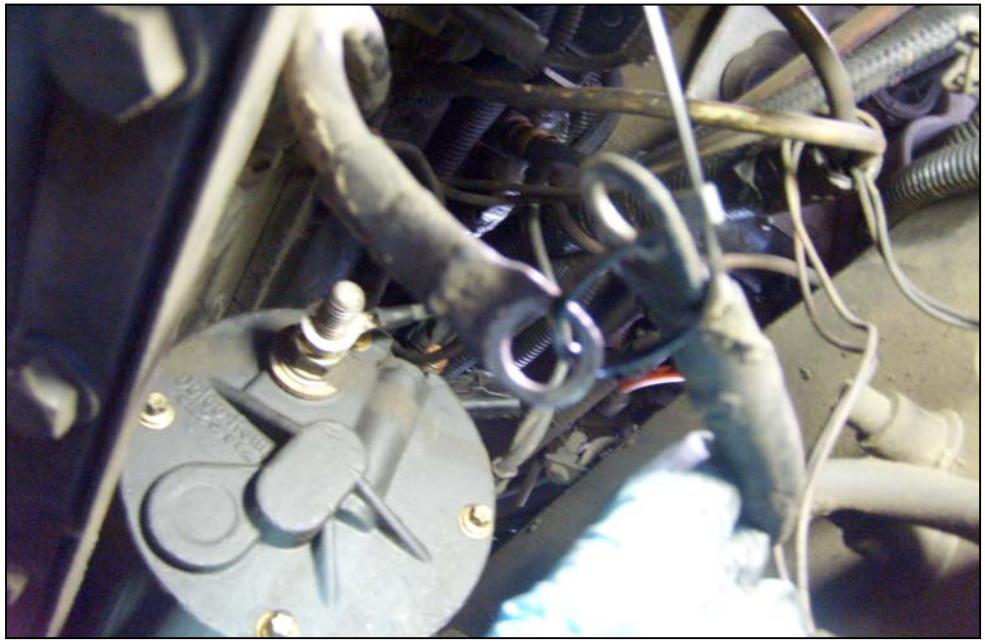
Disconnect and isolate the negative (-) battery cable from the negative (-) battery terminal.

Proceed to starter removal.

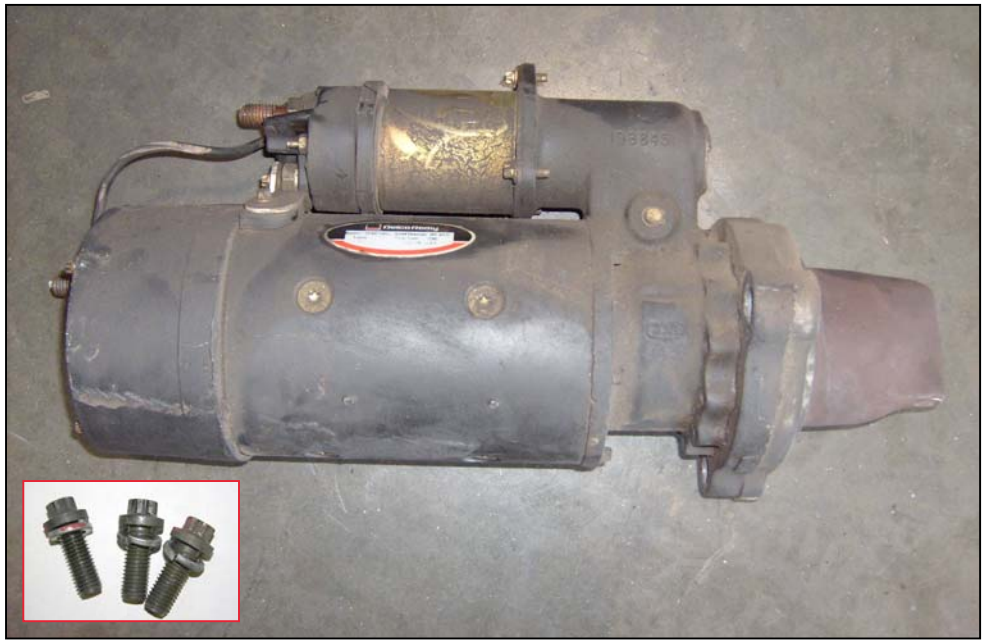
Starter Removal

Before disconnecting cables from the original starter, identify and note location for reassembly.

- **Disconnect & remove all cables from the starter**
- **Temporarily group all positive (+) cables together.**
- **Temporarily group all negative (-) cables together.**



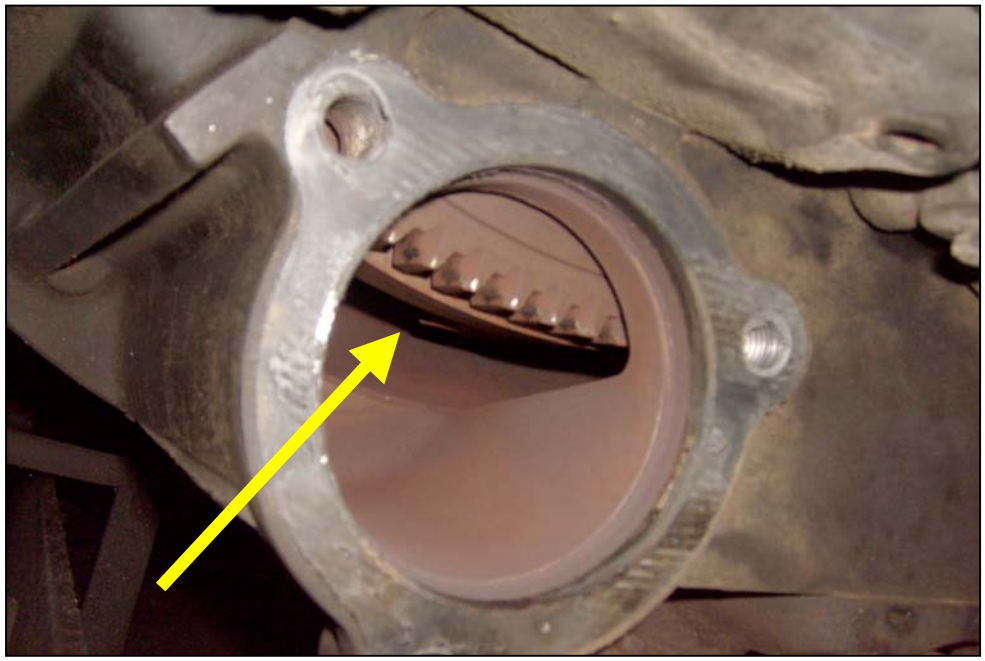
Remove the original starter from the vehicle.



Save the original mounting hardware for the DENSO R5 starter installation.

Proceed to inspection.

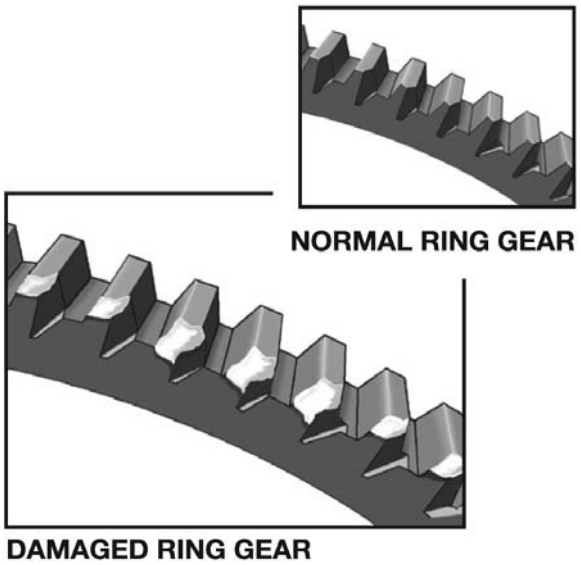
Inspection



Inspect the ring gear for burred or damaged teeth.

Rotate the flywheel and observe the condition of the entire ring gear.

Replace any ring gear which is damaged or has worn teeth with a new ring gear.



Inspection

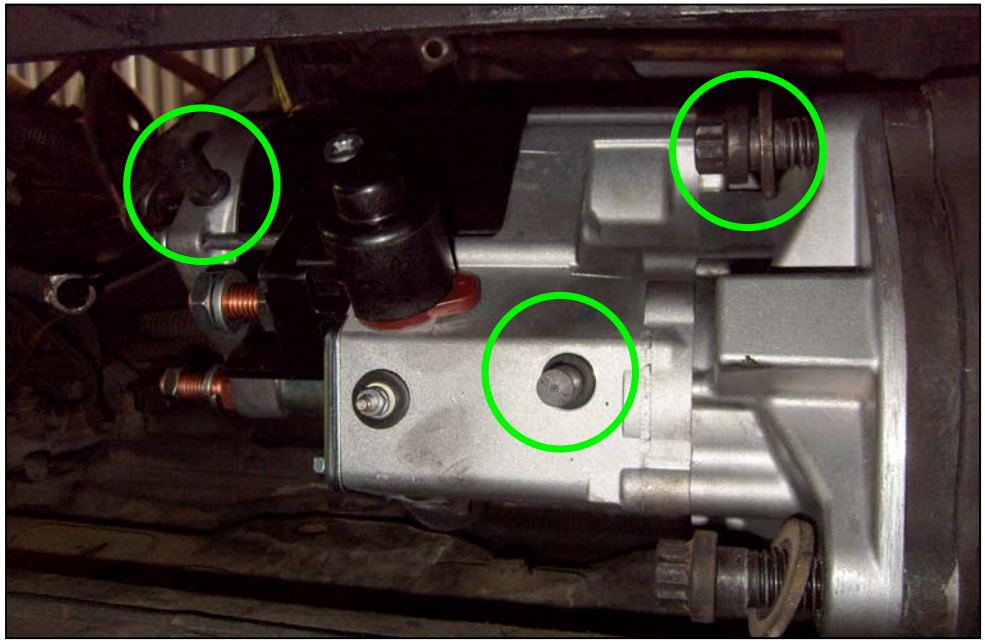
Check the condition of all cables. If out of specification, clean cable connectors or replace cables.

Proceed to starter installation.

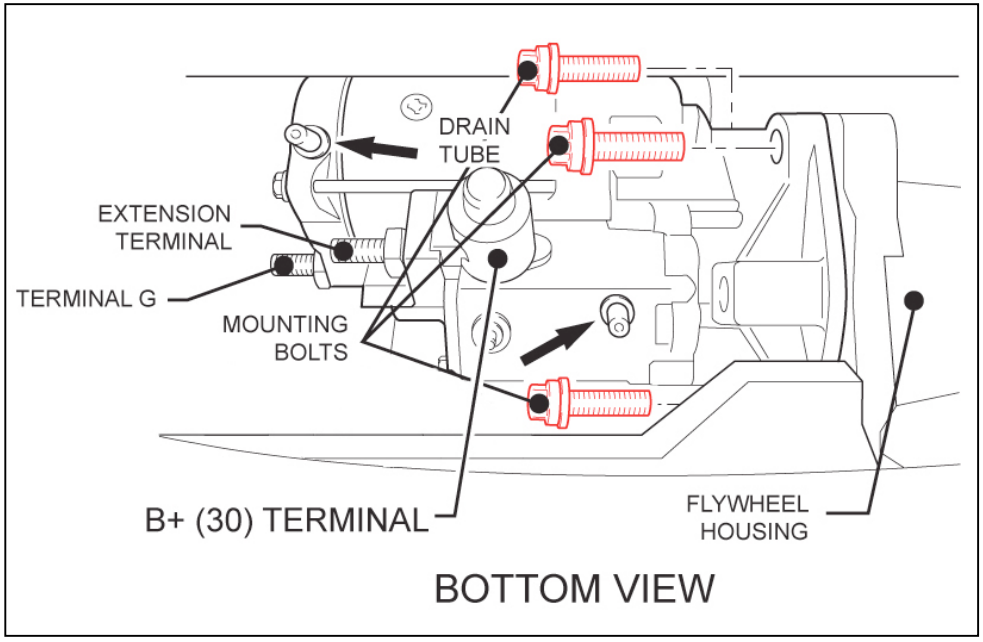
Starter Installation

Temporarily support the R5 starter and secure with the original 3 mounting bolts.

- **Ensure the drain tube is in the downward position**



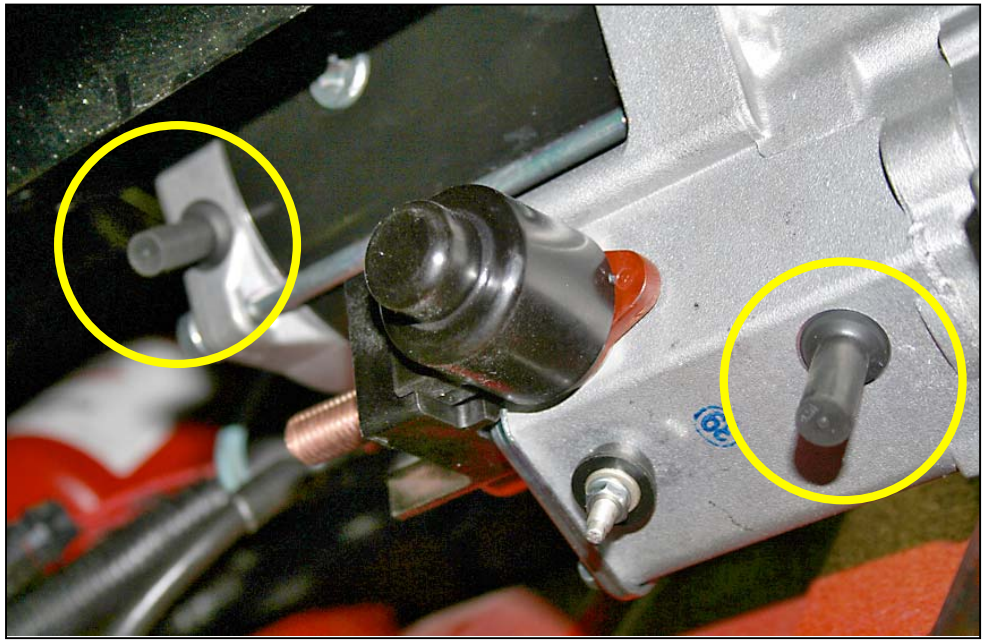
Viewed from bottom of vehicle looking up



Viewed from bottom of vehicle looking up

Starter Installation

NOTE:
Starter shown from bottom view with drain tube in the downward position.



Viewed from bottom of vehicle looking up

Torque the mounting bolts to the specifications indicated in the Cummins N14 service manual.

Viewed from side of vehicle

Starter Installation

Check for <u>minimum</u> clearances of starter to:

1. **Engine Block - 4mm (.16 inches)**
2. **Frame Rail - 25mm (1 inch)**
3. **Heat Source - 30mm (1.2 inches)**
   (e.g. exhaust manifold)

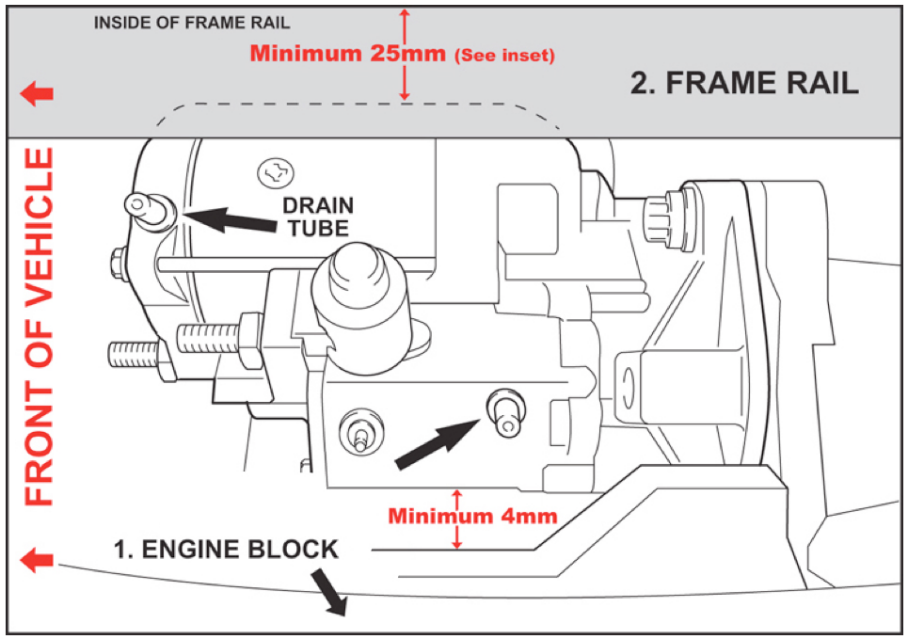


Fig. A

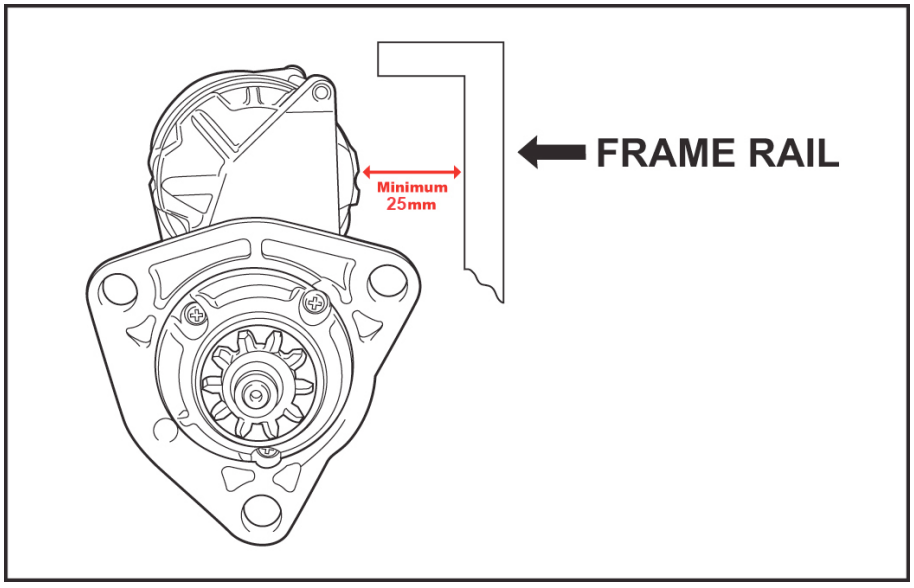


Fig. B

Proceed to wiring assembly.

Starting Motor Overcrank Protection (OCP) Circuit Bypass
(if equipped)

The OCP circuit is an option used on many trucks. It utilizes a thermal switch to open the starter relay ground circuit when excessive starter temperatures are reached due to prolonged cranking of the starter motor. This is commonly called over-cranking.

The information below describes the procedure to bypass the OCP circuit when replacing an OCP equipped starter with a DENSO R5 starter.

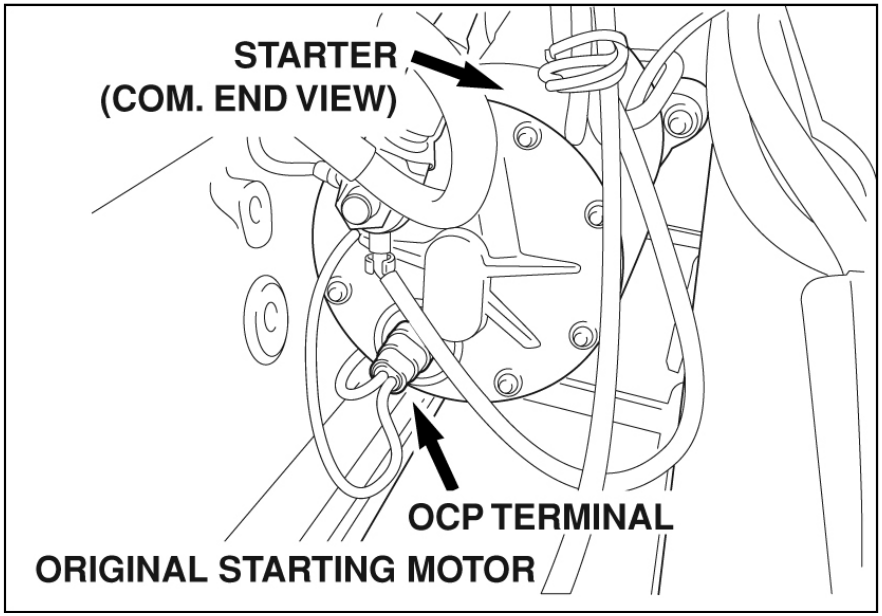
The presence of OCP can be identified by looking at the original starter (commutator end view). The OCP terminal comes out of the main wire harness and is plugged into the thermal switch at the rear of the starter. The DENSO R5 kW starter does not require or have an external OCP device. However, it is necessary to complete the relay ground circuit when installing an R5 kW in a vehicle originally equipped with this OCP device. This can be accomplished by installing a jumper plug into the OCP wiring harness connector.

- DENSO OCP Jumper Plug Part #053680-8010

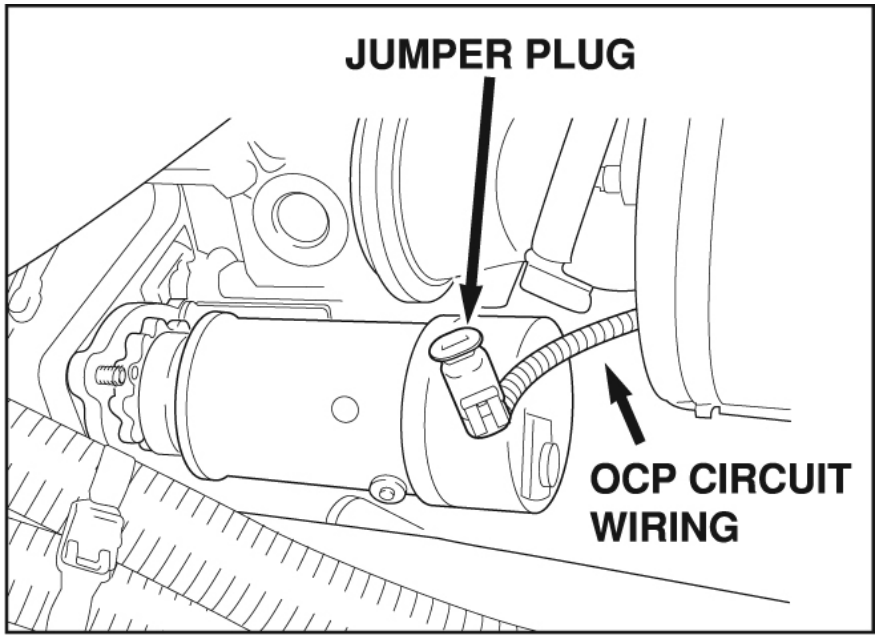
Wiring Assembly

(if equipped with over-crank protection)

Location of over-crank protection terminal in original starter.



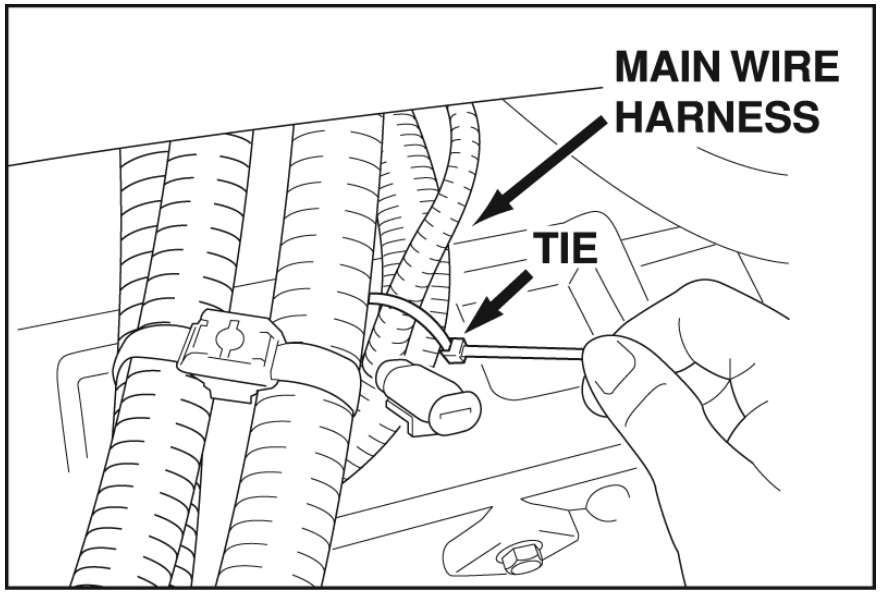
Jumper plug installed in original wire harness.



Wiring Assembly

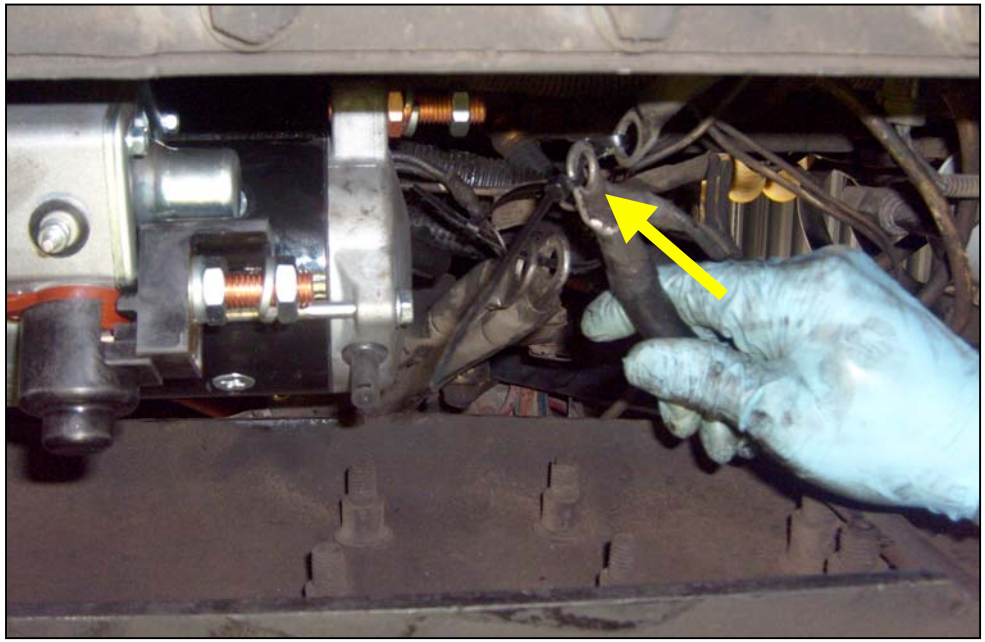
(if equipped with over-crank protection)

Tie off the OCP terminal and jumper plug to the main wire harness to prevent separation due to vibration.

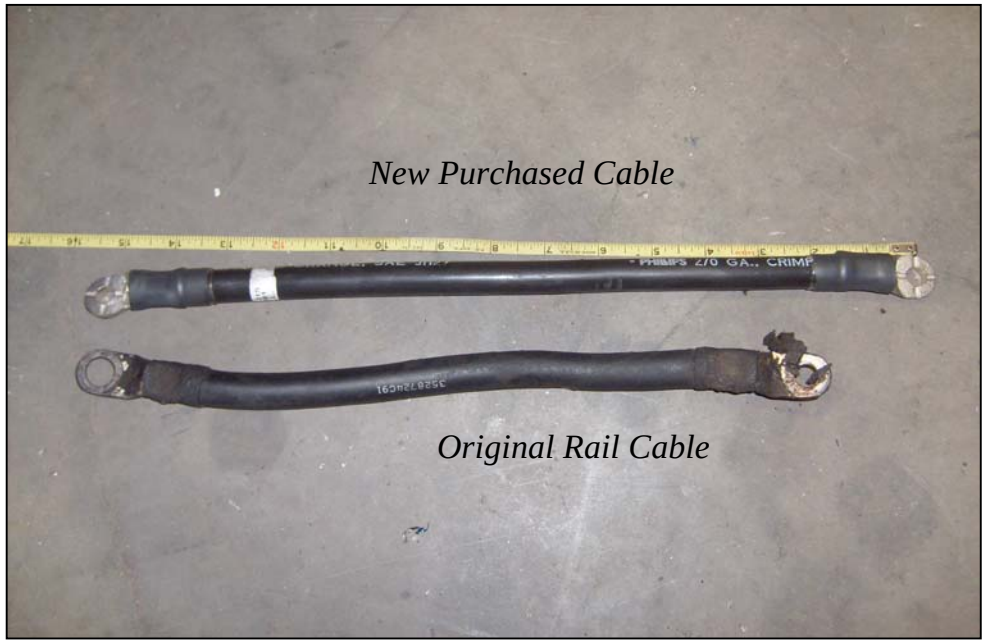


Wiring Assembly

If the length of the rail (chassis) GROUND cable does not reach the ground stud of the R5 Starter, the chassis GROUND cable will have to be replaced.



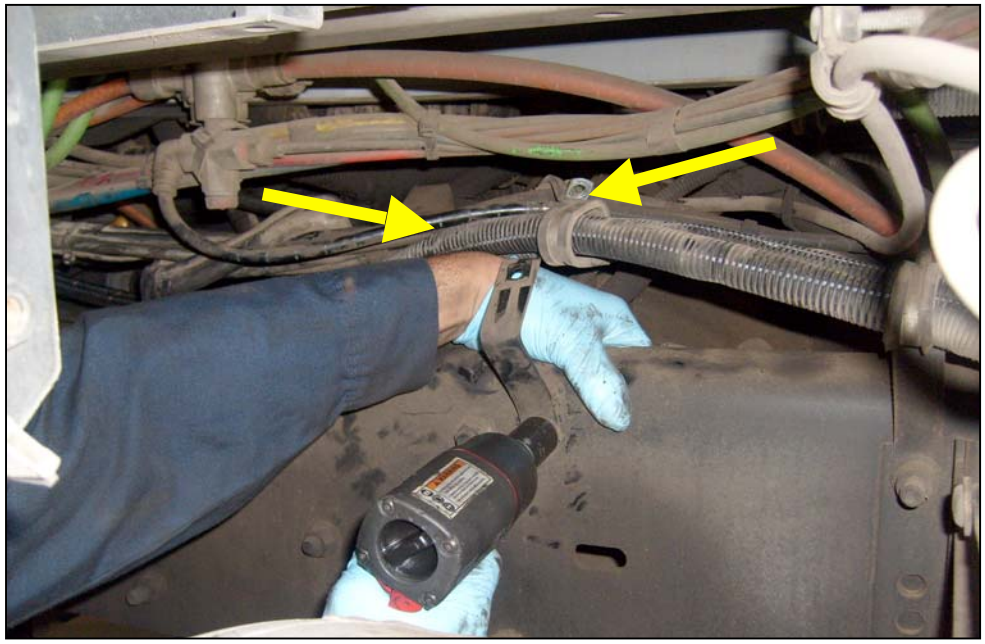
Purchase or fabricate the new ground cable. The gauge of the cable and the cable eyelet must match the original OEM specifications. Modifications may be necessary to assure correct cable fit.



Wiring Assembly

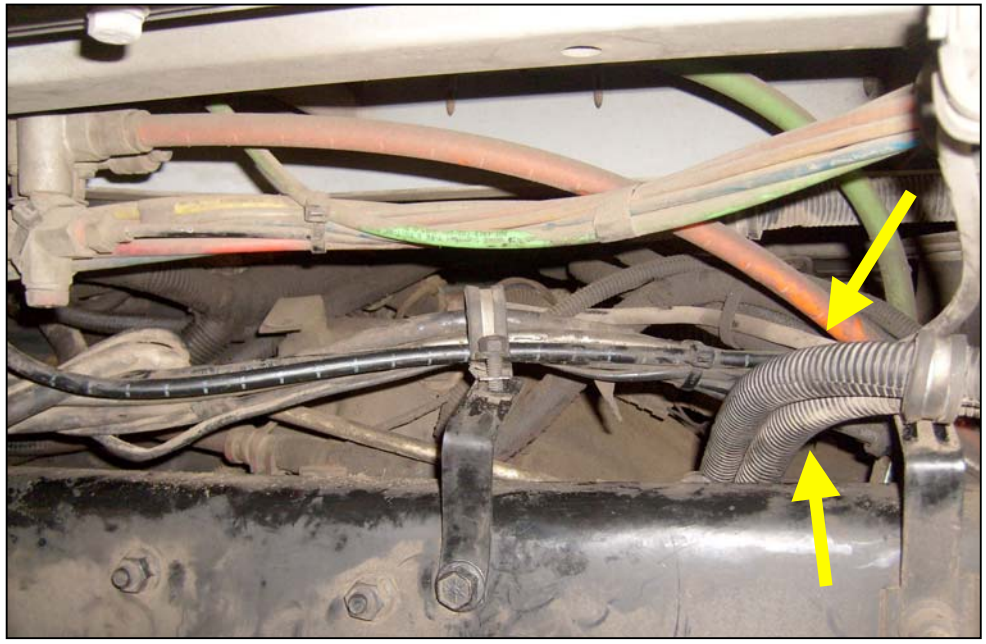
The battery cables from the battery box to starter will have to be rerouted.

Locate the section of battery cables along the rail underneath the cab. Remove original cable ties and loosen cable brackets as necessary. Maneuver the battery cables to the opposite (inner) side of the truck frame rail.



Wiring Assembly

Battery cables must be rerouted, as shown.

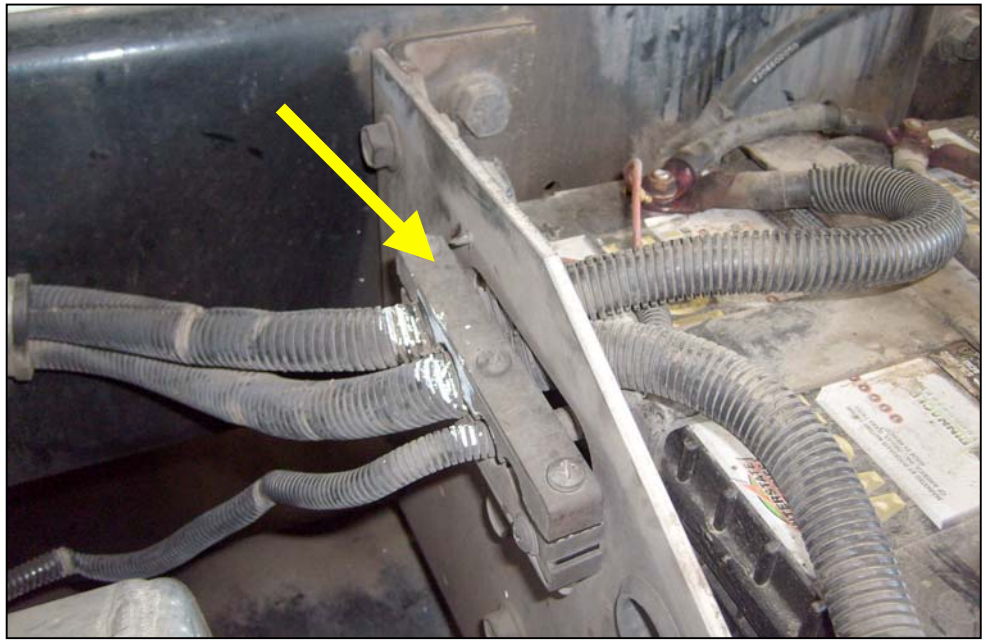


With the cables properly rerouted, carefully maneuver them toward the starter to allow sufficient length for proper connection to the R5 starter B+ (30 terminal).

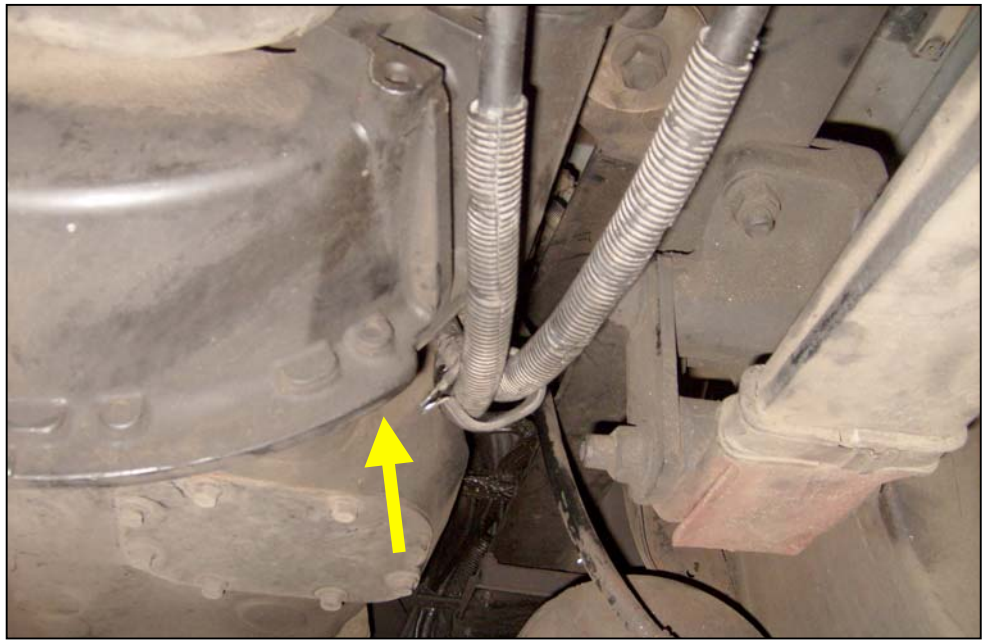
Viewed from bottom of vehicle

Wiring Assembly

If additional length is needed loosen the battery cables at the battery box bracket. Maneuver the cables as necessary.

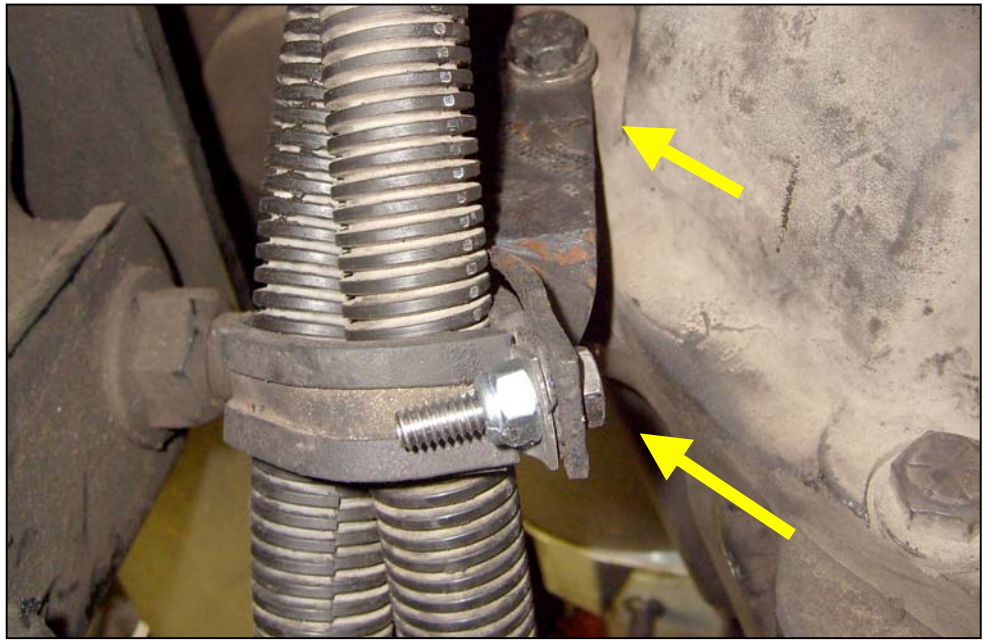


The battery cables will run adjacent (on driver's side) to the transmission bell housing.



Wiring Assembly

Secure battery cables with a new cable bracket attached to the transmission bell housing. Modifications to the bracket may be necessary to ensure proper fit.



Connect all ground cables to the negative stud (Terminal G) and secure in place with retaining nut.

Wiring Assembly

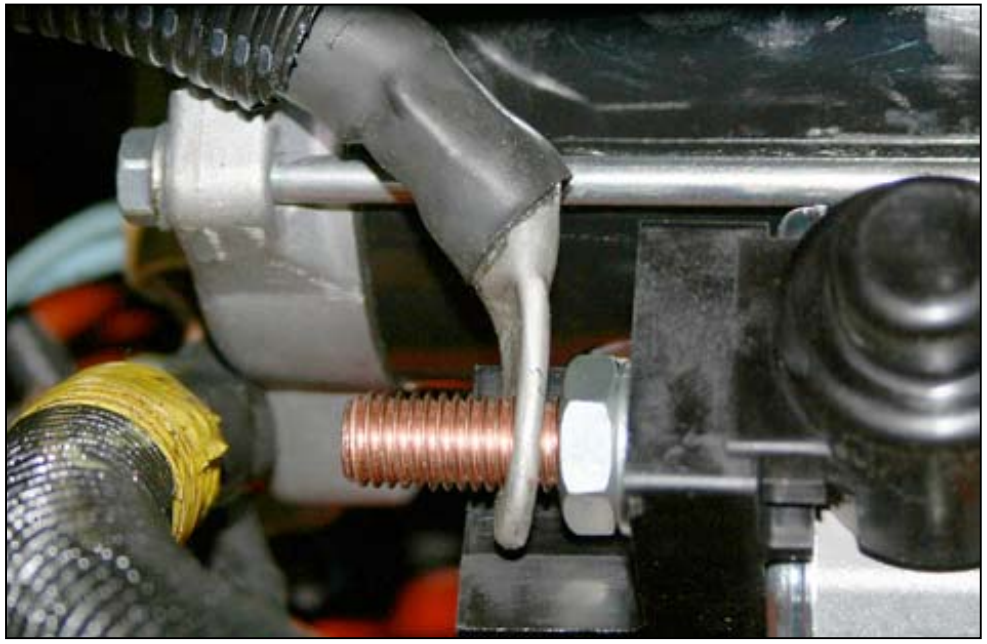
Tighten and torque the Terminal G retaining nut to:

23-30 Nm,
235-306 kgf.cm,
17.00-22.00 lbf.ft.

CAUTION: Do not over-tighten terminal retaining nut. This may cause damage to the retaining nut and negative stud (Terminal G).

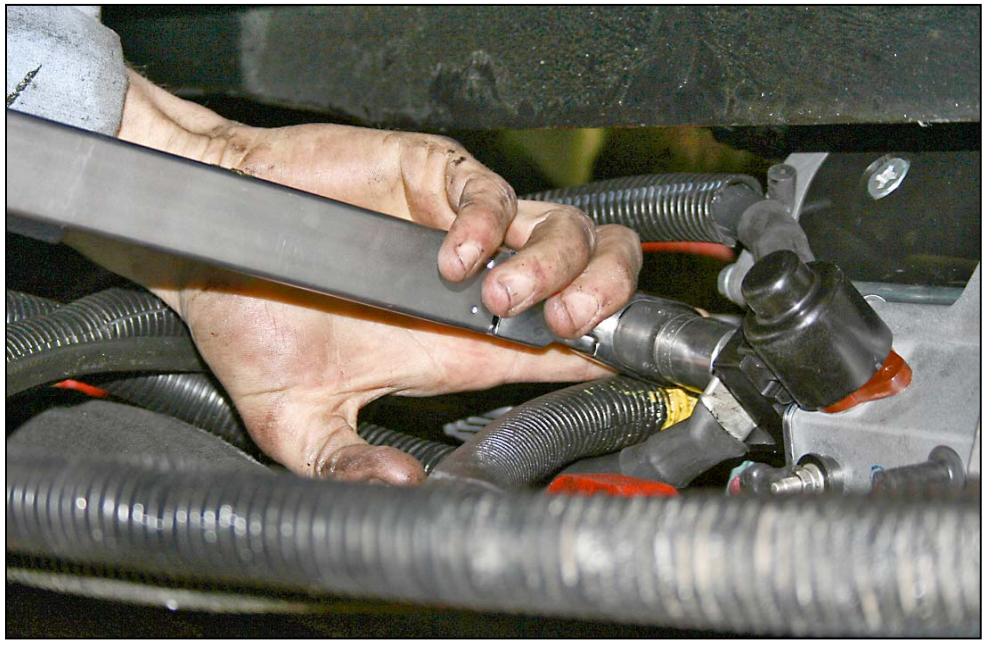
Wiring Assembly

Carefully maneuver the positive battery cables toward the starter to allow sufficient length for proper connection to the B+ (30) terminal.



Tighten and torque B+ (30) terminal retaining nut to:

23-30 Nm,
235-306 kgf.cm,
17.00-22.00 lbf.ft.

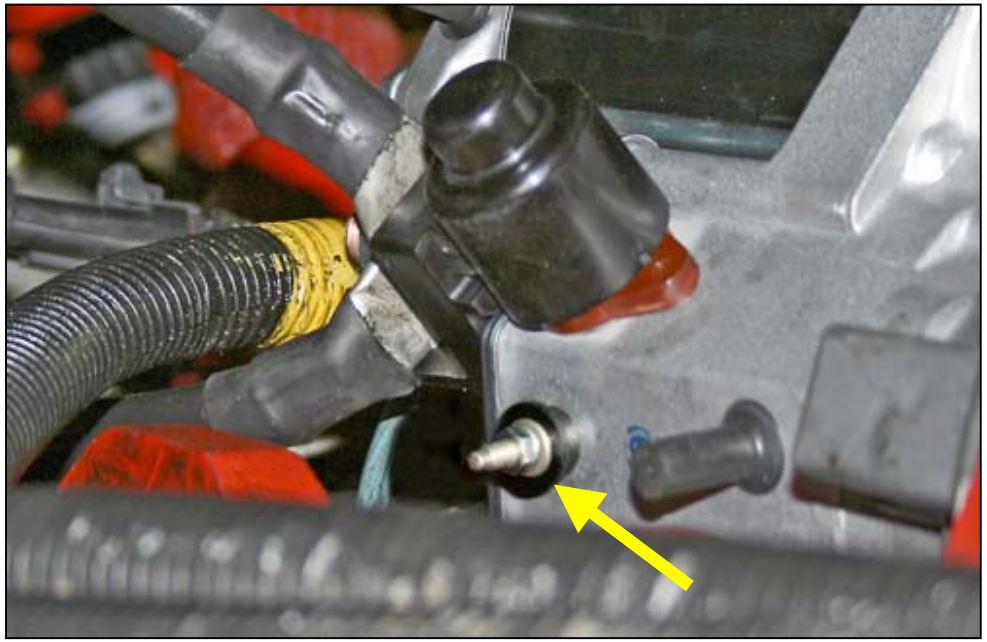


CAUTION: Do not over-tighten terminal retaining nut. This may cause damage to the retaining nut and the B+ (30) terminal.

Wiring Assembly

Locate the 50 terminal (key switch) stud on the starter.

Attach the key switch wire to the 50 terminal stud.



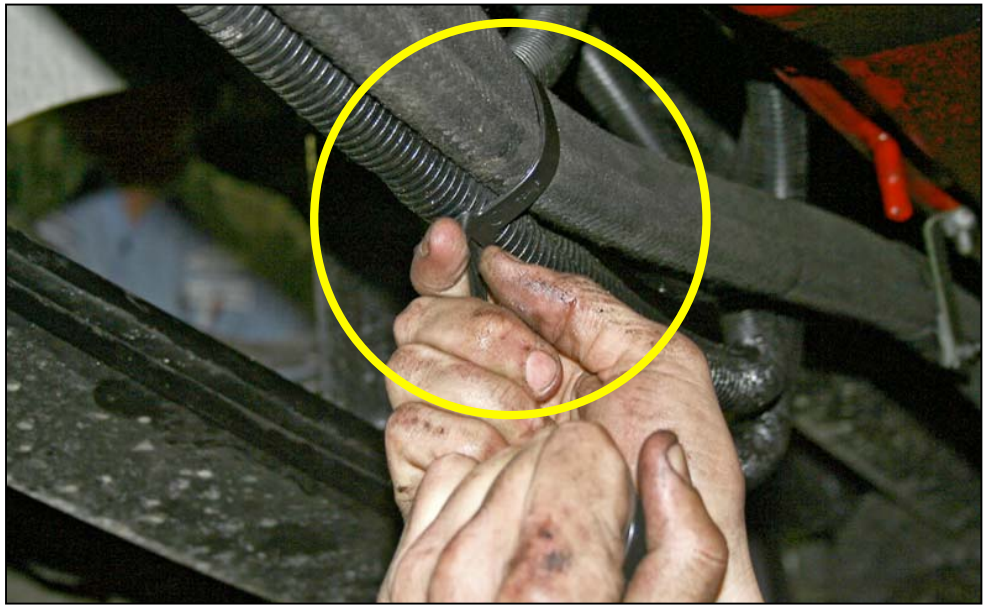
Tighten and torque the 50 terminal retaining nut to:

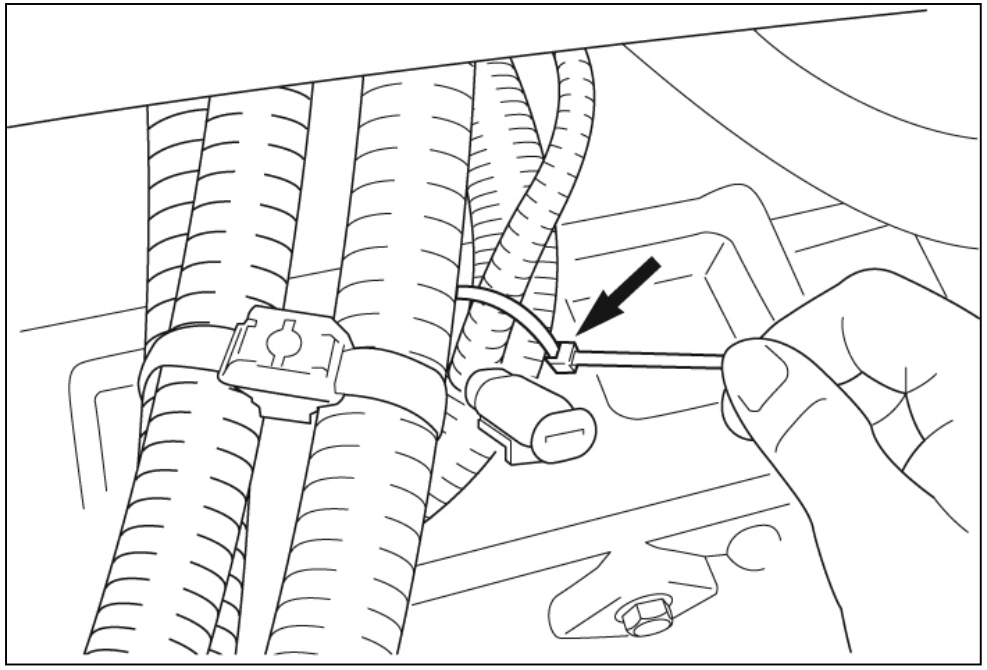
2.6-4.6 Nm,
26.51-47.00 kgf.cm,
2.00-3.00 lbf.ft.

CAUTION: Do not over-tighten terminal retaining nut. This may cause damage to the retaining nut and the 50 terminal.

Wiring Assembly

Properly route and re-secure all cable wiring with new cable ties to avoid contact with frame rail and any external heat source.





Proceed to inspection after installation.

Inspection After Installation

Reconnect the battery cables. Torque to OEM specifications.

A system check should be done by testing the complete battery pack with a diagnostic tool.

Inspection After Installation

A diagnostic tool is required for the following test. A diagnostic tool measures the battery state of charge, battery cable(s), key switch, and vehicle relay resistance losses within the vehicle's electrical system.

The diagnostic tool should have the following features/capabilities:

- Performs a load test on 12 or 24 Volt battery systems.
- Performs a starter Amp (Ampere) draw test.
- Digital display gives good, bad or marginal battery condition with voltage, state of charge and estimated 200-1600 CCA (Cold Cranking Amperage).
- Digital display gives the Voltage Drop at specified Amps and Volts including both Positive and Negative vehicle starter cables.
- Able to withstand a 120 Amp load capacity.
- Able to measure a volt range between 0-40Volts.

Inspection After Installation

Perform a battery system test. The diagnostic tool will ask for the quantity of batteries in the system. Enter the quantity of batteries on the vehicle.

The diagnostic tool will also ask for the rated CCA (Cold Cranking Amperage) of ONE battery, and also for the temperature of the batteries. Enter the CCA and temperature of one battery.

The diagnostic tool will then run the test automatically, displaying the test results.

If the system test fails, all batteries must be tested individually.

If the system test does fail, disconnect all battery cables from each battery and test each battery with the diagnostic tool.

Inspection After Installation

Cable Voltage Loss Test

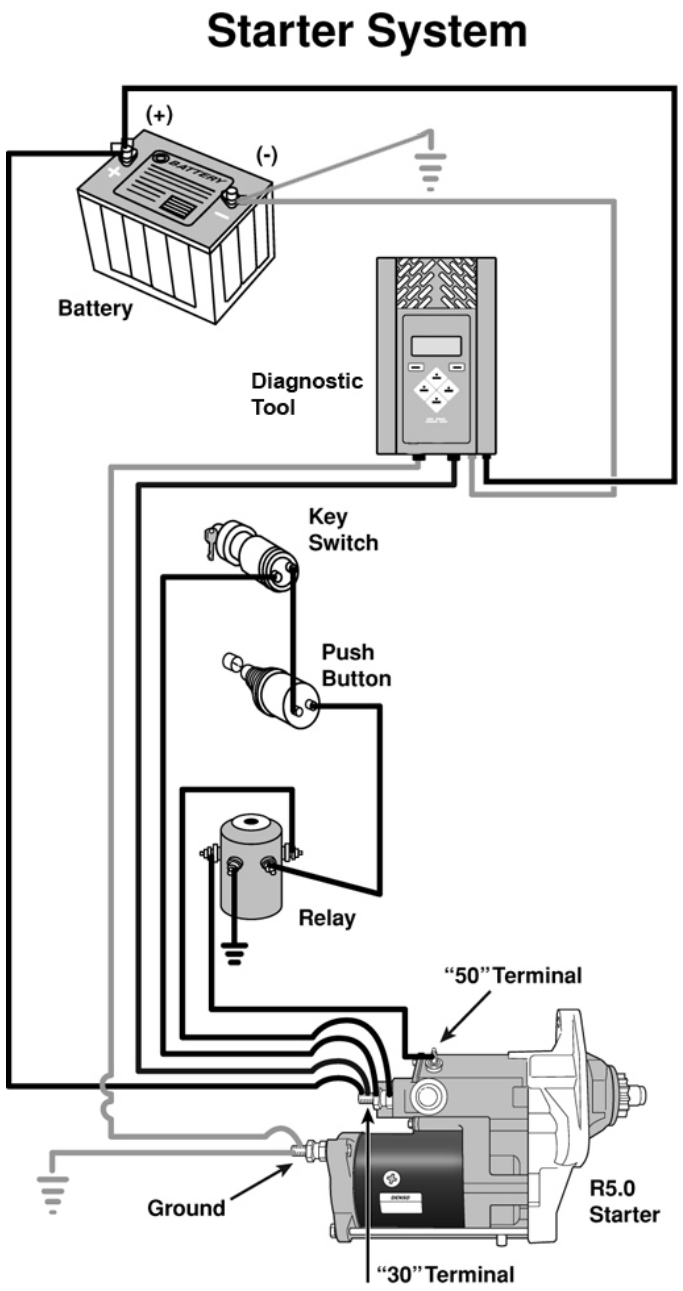
1. Connect the diagnostic tool as shown in diagram.

2. Run test on the diagnostic tool (main cables).

3. Record voltage loss value indicated on the diagnostic tool.

If total voltage loss exceeds 0.5V @ 500 amps, repair or replace cable.

In accordance with The Maintenance Council RP129 Section 1(B).



Inspection After Installation

Replace ALL removed vehicle components, such as the battery cover.

Start engine and check for proper operation.

CONGRATULATIONS!

You have successfully installed the DENSO R5 Starter.

For Additional Assistance or Technical Support Contact:

DENSO Sales California, Inc.
Tech Hotline at 1.800.366.1123